known educator and student of anthropology. The faculty has been chosen by the president, and elected to serve indefinitely on good behavior, instead of being reelected annually as at the Agricultural College. In so young a school much remained for the future, but progress has been steady and satisfactory, and the institution was beginning to amount to something as a scientific center.

All this is now to be changed. All along there had been attempts within and without the board of regents to effect undesirable changes, but so far it had been possible to suppress them, and the faculty usually heard nothing of them. However, when a member of the board recently resigned because he was leaving New Mexico, Governor Otero appointed for the unexpired term a man who was well known to be hostile to the existing management. After a time it became plain that a destructive policy was intended, and Mr. Springer resigned from the board. The faculty held a meeting to discuss the situation, and sent one of their number to represent the facts to Governor Otero. The governor, however, offered no relief and plainly intimated that if we resigned there were plenty more where we came from. It was then decided to lay the matter before the public, and a printed pamphlet was issued, setting forth the conditions in detail. This was well received by the public and the students, the great majority siding with the faculty; the students especially being practically unanimous, and passing resolutions expressing their opinions. The City Council of Las Vegas also passed resolutions in favor of the faculty. In the face of all this, however, Governor Otero reappointed the regent objected to for a full term, and appointed in Mr. Springer's place one of the regular politicians. In these actions he was supported by the council of the recent New Mexico legislature, which has been exceptionally corrupt and incompetent. Hence the faculty goes.

T. D. A. COCKERELL.

LAS VEGAS, N. M.,
April 12, 1903.

SHORTER ARTICLES.

THE USE OF PNEUMATIC TOOLS IN THE PREPARATION OF FOSSILS.

THE tedious work of removing fossils from their matrix by means of the hammer, chisel and awl has led to various experimentation with machine tools in the hope of devising some more rapid method. The dental engine and the electric mallet have been in use in some laboratories for a number of years, and have proved very efficient in such work as the removal of hard matrix from small skulls. However, their efficiency has so far been limited to light work. This is probably due in a large part to the fact that the tools used are those constructed for the lighter work of dentistry. It is also generally conceded that electric appliances have not proved a success in percussion tools.

Pneumatic tools were introduced into the paleontological laboratory at the Field Columbian Museum by the writer some four months ago, and may now be said to have passed through the experimental stage. The application of these tools to fossil-cleaning has proved so successful that it has seemed worth while to call attention to their use in this work.

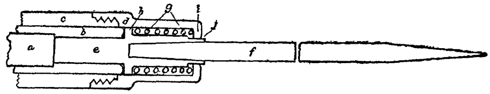
The pneumatic hammer as used in chipping and riveting metals and in stone-cutting is too well known to require description here. However, only the lightest hammers used in stone-cutting come within range of our present consideration. These are manufactured by a number of firms in the United States and are of two types, the pistol-grip and the straight cylinder. The latter type has been adopted by the writer on account of greater convenience in bringing the tool into use in work in all positions. Experimentation has shown that the smallest hammers on the market as stone working tools are heavy enough for any work on fossils. A still smaller size would often be convenient.

The hammer in use consists of a cylindrical chamber in which a five-eighth-inch steel plunger having a five-eighth-inch stroke is caused to play upon the head of the chisel at the rate of 3,000 to 3,500 strokes per minute.

This rapid succession of light blows sets up a vibration in the chisel, which, with even a slight pressure against the work, gives it a remarkable cutting capacity. In fact a chisel so driven will cut an indurated clay as rapidly as an ordinary hand tool will cut chalk.

The chisels commonly used in stone cutting are made uniformly of one-half-inch square or octagon steel about nine inches in length. Of these one and one half inches of the head end is turned down to three-eighth-inch diameter, so as to fit into the chamber of the tool and provide the shoulder necessary to hold the chisel at the precise point which will render the stroke of the hammer most effectual. These chisels are used indiscriminately in all sizes of stone hammers and are ill adapted for the preparation of fossils. The requisite for such delicate work is a keen stroke under complete control. This has been in a measure attained by fitting an attachment to the stone cutting hammer.

In the accompanying figure *a* represents the plunger, *b* the hard steel barrel and *c* the softer outer jacket of the hammer. A tempered steel cylinder *d* is attached to *c* by a heavy thread; this holds in position a separate tool head *e*, which receives the blow of the hammer and bears the chisel *f* in a taper socket. A coil spring *g* acting against the shoulders *h* and *i* in turn receives the blow of the hammer or any part of it not util-



Cross-section of Pneumatic Hammer, with Tool-holding attachment.

ized in work at the point of the chisel. The tool head *e* is fitted to a square opening in *d* at *j* which prevents rotation. The taper-socket holds the chisel in place so that it may be guided by the hammer; when desired the chisel may be readily released by placing in a vise and tapping the tool head lightly. One escape-vent is directed forward so as to blow away dust and small chips from the work. For chisels, one-fourth-inch round steel cut in six-inch lengths and drawn to a point of one-eighth or three-sixteenth inch in breadth are most efficient. For finishing, a broader bladed chisel may be used to advantage.

This appliance makes it possible to dispense with the unnecessary weight of metal in the chisel so that a keener stroke and a greater cutting capacity result. At the same time the manipulator is relieved of the necessity of holding the chisel in place with the left hand and so avoids the benumbing jar caused by the vibration.

The advantages of this hammer over the old-fashioned hammer and chisel are its much greater cutting capacity and its freedom from the jar which causes so much breakage in specimens encased in hard matrix. The relative cutting capacity depends upon the nature of the material to be removed. If it be sandstone, by which tools are rapidly dulled, blocking off in large pieces by means of hammer and chisel will be found more expedient. Or if it be a very hard substance, such as quartz or chalcedony infiltrations, a method of spalling by means of a square-poled hammer may prove more efficient than either. But in limestone or any of the indurated clays the superiority of the pneumatic hammer is at once evident. This is especially true in the case of complicated specimens where there are deep cavities or foramina to be developed. In such work the pneumatic chisel can be used wherever its point can be introduced, while with the old-fashioned hammer and chisel one is often at a loss for room to hold and strike. The cutting capacity of a chisel is much greater also when used with the pneumatic hammer, as the point can be made much harder without danger of breaking. Chisels made from a high grade English steel of 1.4 per cent. carbon chilled to a file-like hardness may be used four or five hours in concretionary clays without need of grinding.

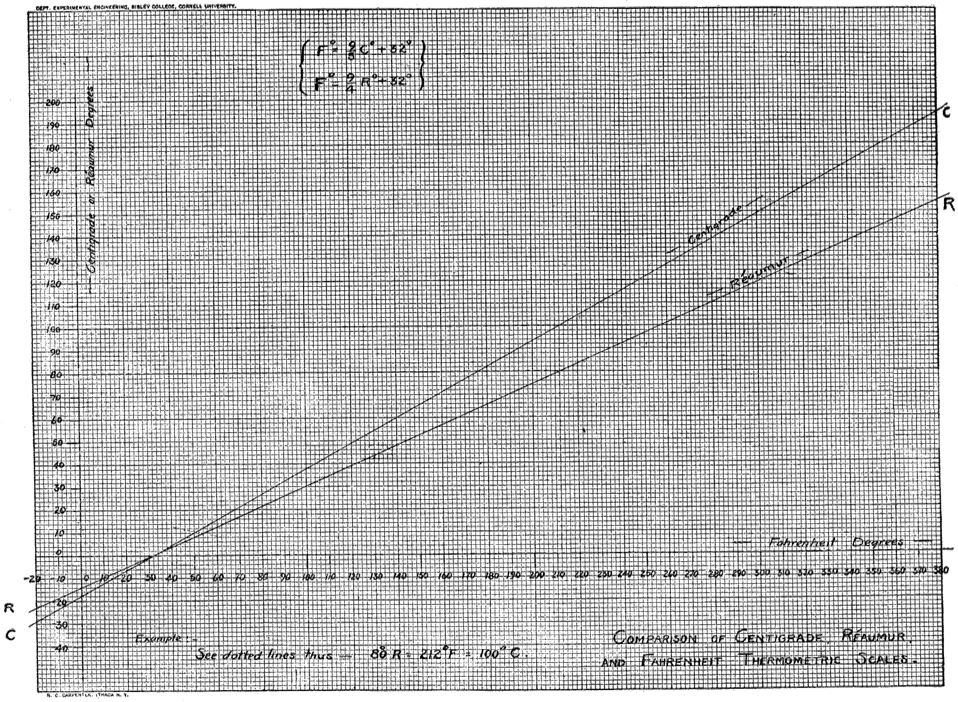
The advantage of relieving the specimen from the jar of the hand-hammer can scarcely be overestimated. In working out dinosaur vertebræ from a concretionary matrix by means of hand tools we have often found it necessary to break the specimen to pieces with a hammer in order to remove the chalcedony-filled masses of concretion from the

cavities. The use of the pneumatic chisel has made it possible to remove the matrix from such cavities, with but little injury to the specimen. The tendency to chip off thin edges with flakes of the matrix is also avoided.

Skill in the use of these tools is readily acquired. By adapting the size of the chisel to the work in hand and gauging the amount of air admitted to the tool by means of a push-button throttle valve, the stroke can be reduced so that a scale may be removed from the most delicate surface.

E. S. RIGGS.

FIELD COLUMBIAN MUSEUM.



THERMOMETRIC READINGS.

HAVING had frequently occasion to transfer thermometric readings given in one of the common systems, Centigrade, Fahrenheit and Réaumur, into one of the others, the accompanying diagram has been developed, which affords a convenient and rapid means of such transformation, and is adequate, provided a high degree of accuracy is not desired. The relations between the three systems are given by the following formulæ:

$$F.° = \tfrac{9}{5}\,C.° + 32° = \tfrac{9}{4}\,R.° + 32°.$$

Fahrenheit degrees being plotted along a horizontal axis, and Centigrade or Réaumur degrees along a vertical axis, the graphs of the two equations above give two straight lines, as shown, from which, having given a reading in one of the systems, the corresponding reading in either one of the other two may be obtained.

Thus to find the equivalent of 80° R. the horizontal from the 80° division on the vertical axis is followed to its intersection with the line marked Réaumur, thence downward where the corresponding Fahrenheit reading (212° F.) is found on the horizontal axis; or upward to 'Centigrade' line and thence horizontally to left where the corresponding Centigrade reading (100° C.) is found on the vertical axis.

Both lines cross the horizontal, or Fahrenheit, axis at the same point, 32°; the Réaumur